CENNS - ERC and Ricochet:

Probing new physics with Coherent Elastic Neutrino-Nucleus Scattering and the future Ricochet experiment

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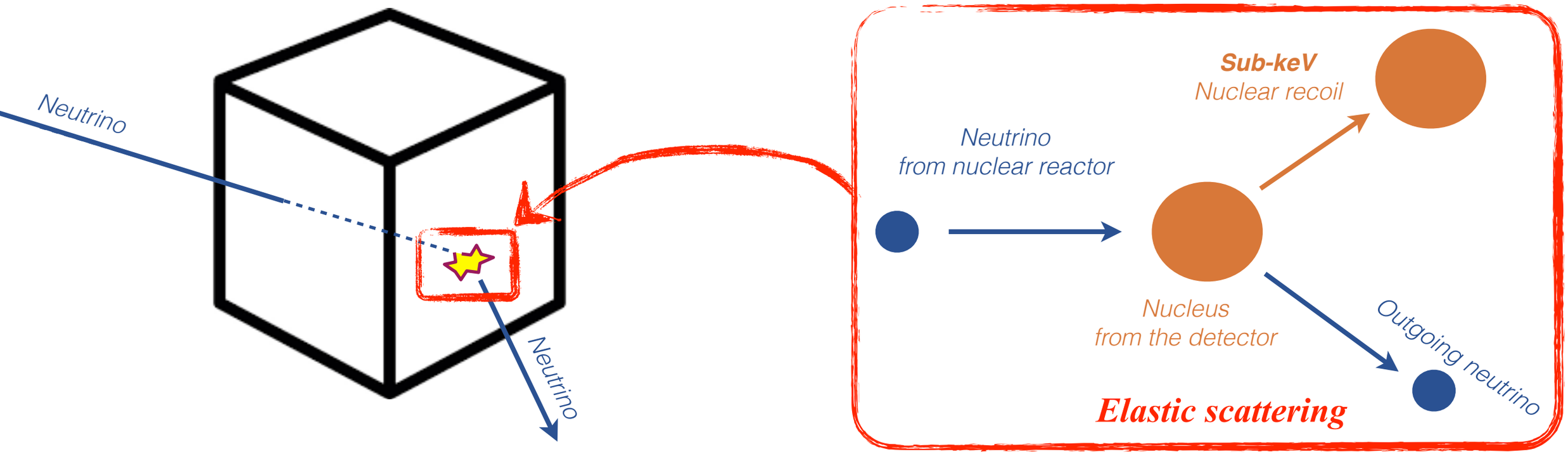
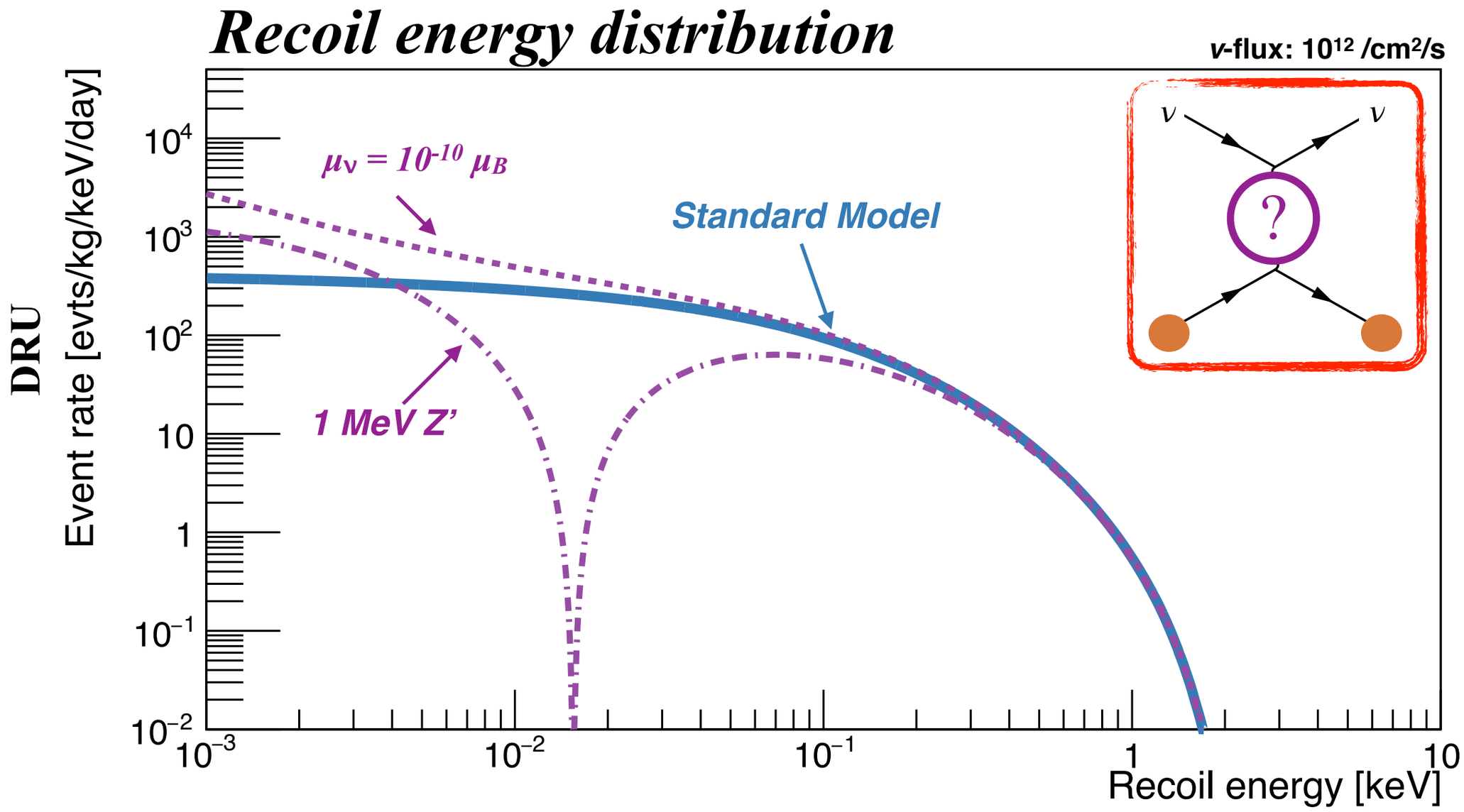
CENNS: *The process*

Coherent **E**lastic **N**eutrino-**N**ucleus **S**cattering (CENNS)

- Predicted in 1974, only recently detected (COHERENT collaboration, *Science **2017***)
- The cross section scales as A^2 **BUT** produces ***sub-keV*** nuclear recoils
- Largely dominating cross section <10 MeV neutrinos: ***from ton-scale experiments to kg-scale ones !***
- A new probe for physics beyond SM ?: ***calls for low-energy and high precision measurement***



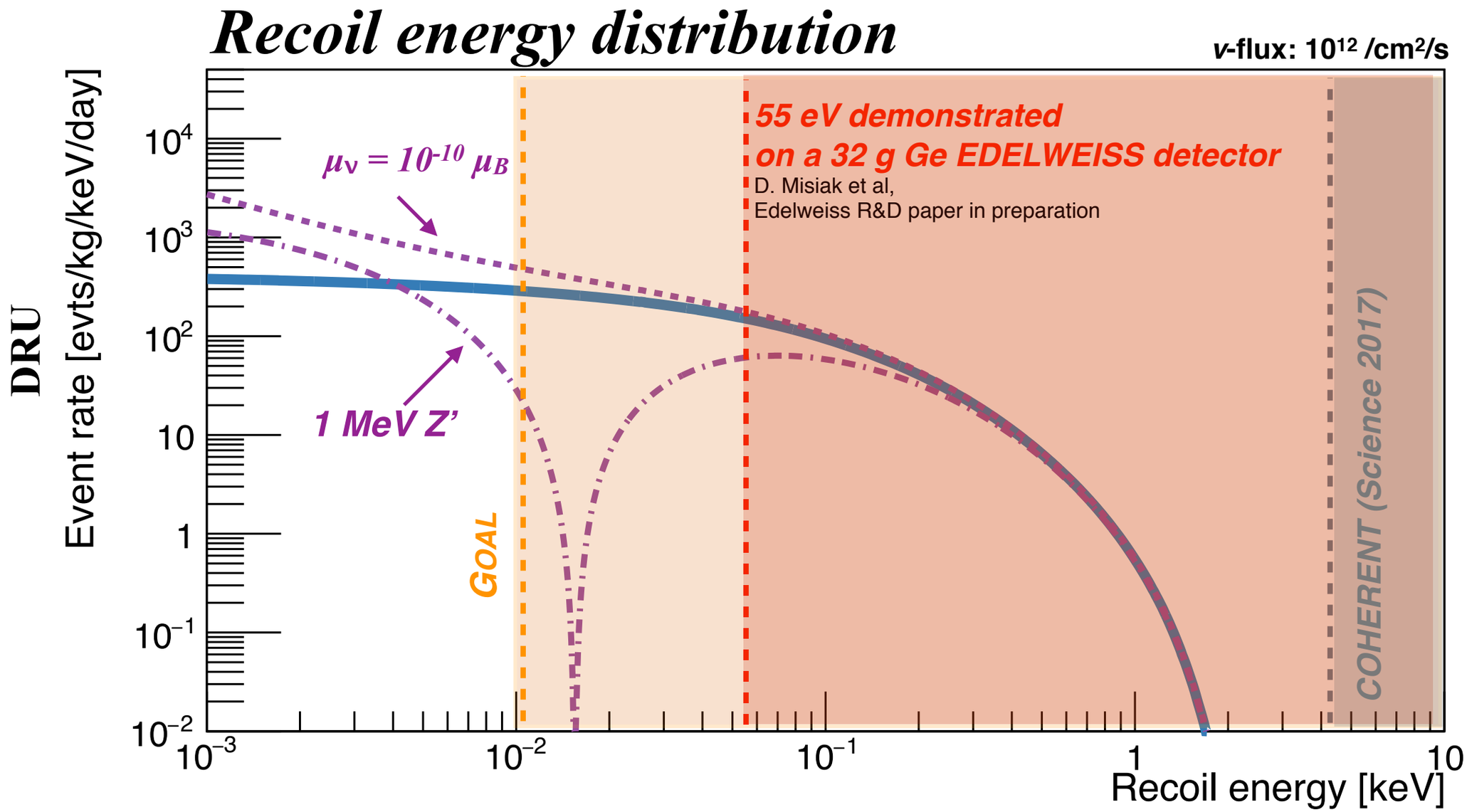
CENNS: *searching for new physics*



New physics signatures (massive mediators, anomalously large NMM, Non Standard Interactions, ...) will arise at the lowest energies

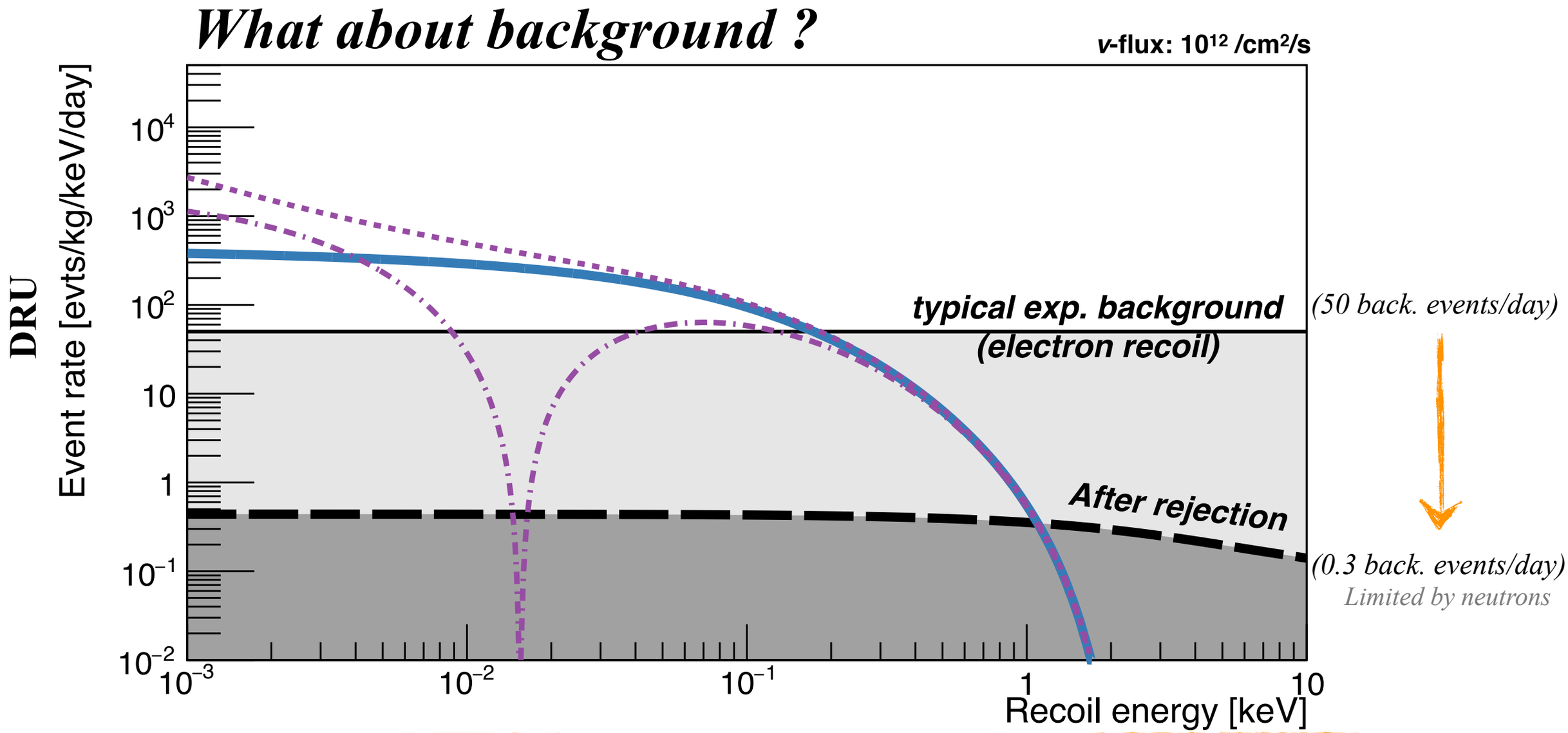
Calls for very low-energy thresholds: O(10) eV

CENNS: *searching for new physics*



O(10) eV threshold should not be a problem with 30g Ge EDW-like detector

CENNS: *searching for new physics*



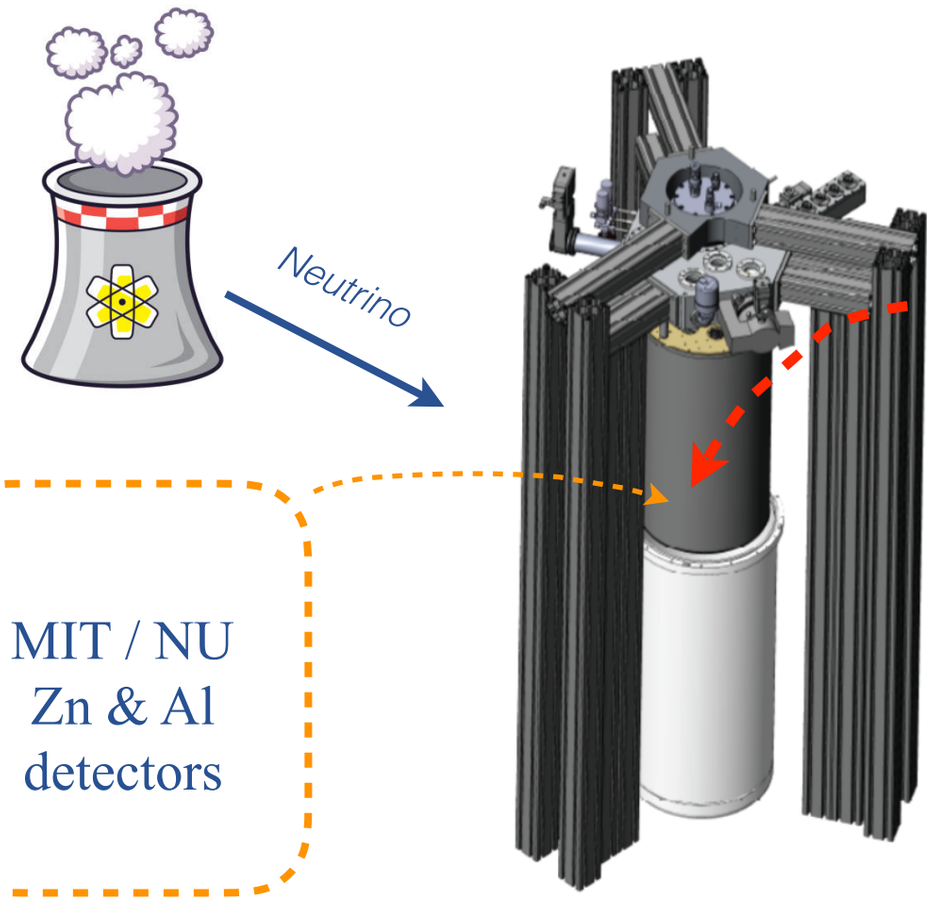
Expect to be overwhelmed by the backgrounds

Calls for particle identification to reach background rejection of ~10²-10³

Detector R&D will focus on this point

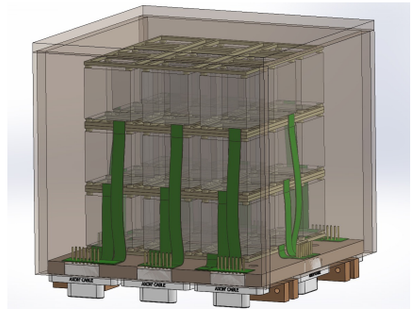
RICOCHET
A Coherent Neutrino Scattering Program

« The first low-energy kg-scale CENNS neutrino observatory combining multi-target and multi-technology cryogenic detectors » Proposal paper: *J. Billard et al., J. Phys. G (2017)*



MIT / NU
Zn & Al
detectors

CRYOCUBE
Ge & Zn (& Si?)



CENNS - ERC

The CENNS - ERC will be funding the CryoCube

1kg of cryogenic Ge and Zn detectors with O(10) eV threshold and 10^3 rejection

RICOCHET is actively looking for new collaborators

CENNS - ERC / Ricochet: *Timeline*

CENNS - ERC Research Program

Principal Investigator: J. Billard (IPNL)

2019 — *2020* — *2021* — *2022* — *2024*

WorkPackage 1

Single crystal detector design

'reaching $O(10)$ eV energy threshold with 10^3 particle identification'

WorkPackage 2

Scalability

'From a single 30 g detector to a kg-scale detector array - **CryoCube** '

WorkPackage 3

%-level CENNS measurement

'Accurate low-energy calibration and advanced statistical analysis'

Collaboration with theorists

RICOCHET experiment

International Collaboration: CNRS, MIT, NU, WU, ++ ?
IN2P3 master project (IPNL, CSNSM, ++ ?)
IN2P3 Scientific coordinator: J. Billard (IPNL)
Local coordinators: S. Marnieros (CSNSM) and J. Billard (IPNL)
Technical coordinator: A. Juillard (IPNL)

CryoCube integration

Commissioning

Data analysis

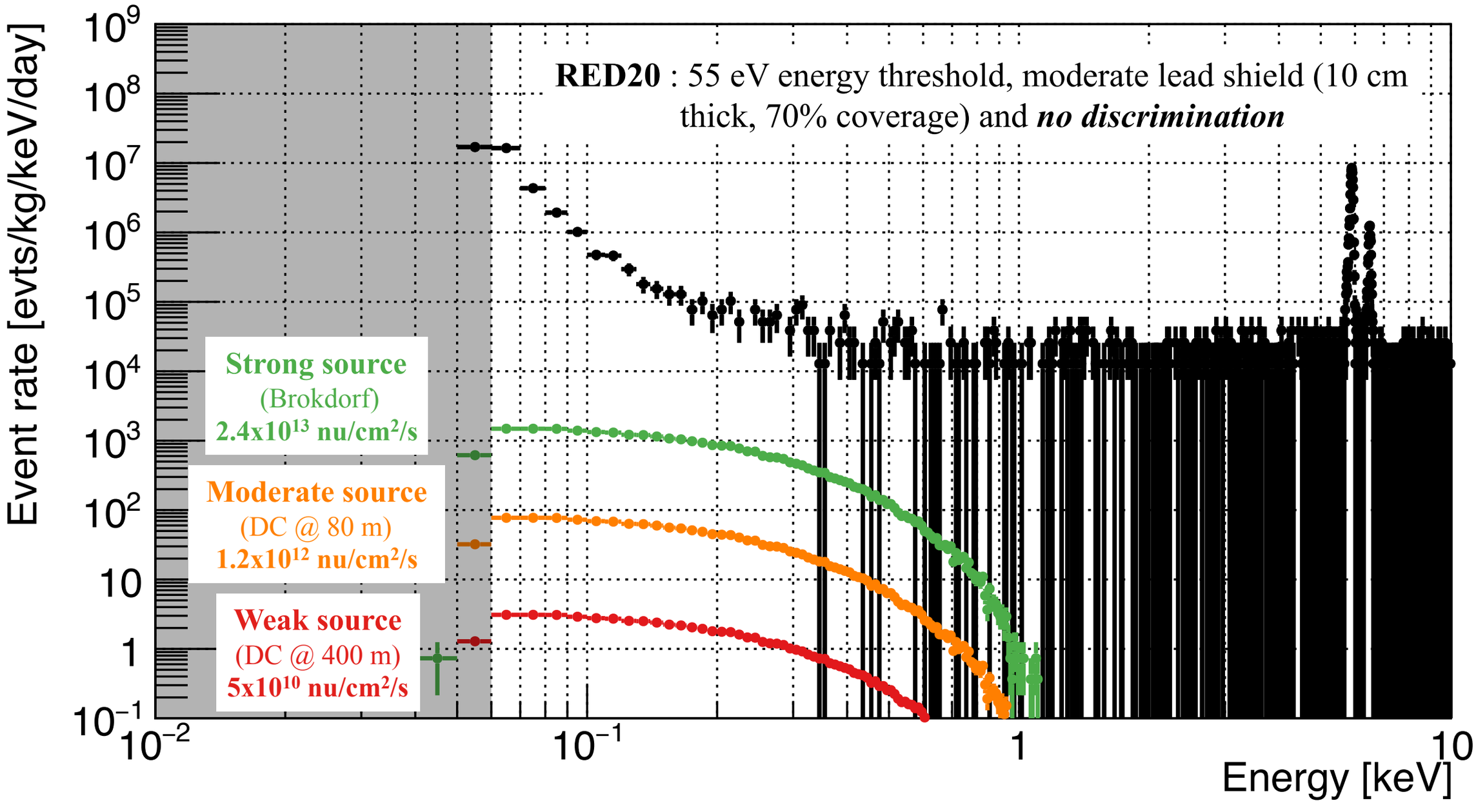
Finalizing design → Ricochet installation → Science data

RICOCHET will be writing a CDR in the coming year

- *To be presented in a IN2P3 CS or Project Review end of 2019*
- *Help and funding expected from IN2P3 will be detailed*

Ricochet: *Nuclear site prospection*

- The Ricochet collaboration is actively looking for its optimal nuclear reactor site with ***large signal*** and ***reasonable overburden*** in France and abroad (**decision: end-2019**)
- We have performed in depth studies at MITR *(JINST 2018)* and Double Chooz (*J. Phys. G. 2017*)



Conclusion

Since its first detection by the COHERENT collaboration in July 2017, CENNS has become a burgeoning field of research : intense competition expected !

CENNS - ERC is dedicated to develop the next generation cryogenic detector to perform a low-energy percentage-level precision CENNS measurement (CRYOCUBE) and deliver science by 2024 after integration in Ricochet cryostat by 2022.

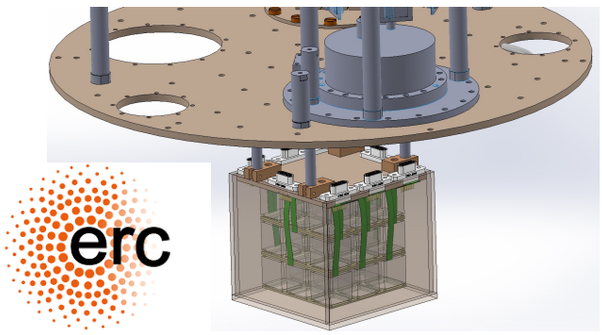
Key features of the CRYOCUBE are low threshold AND discrimination.

Ricochet is a growing international collaboration dedicated at building the first low-energy neutrino observatory. Site decision by end-2019.

It is an R&D oriented **IN2P3 master project** (*to be upgraded to a regular master project?*) with two labs: CSNSM and IPNL, looking for more collaborators.

Ricochet is working on a CDR to be delivered to the institutions by end-2019 to seek fundings and resources for its deployment at an optimal reactor to be ready to host the CRYOCUBE by 2022.

kick-off meeting will be organized by the French members of RICOCHET in the beginning of 2019



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